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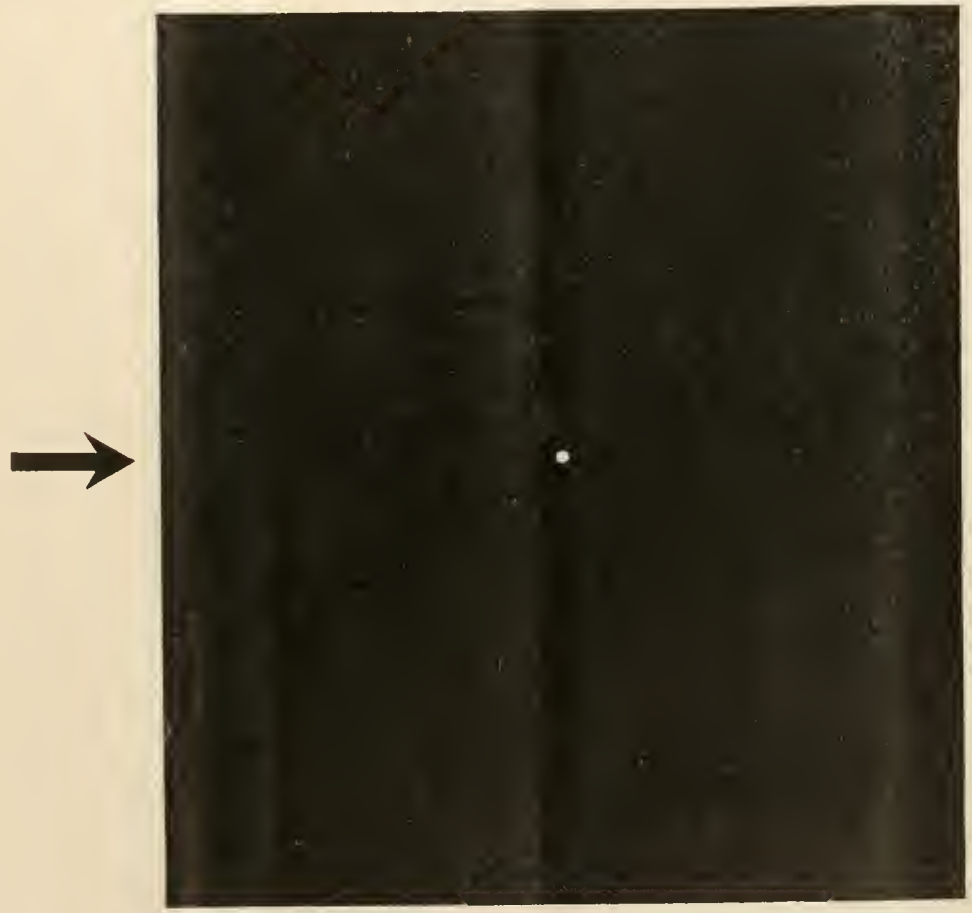


THE HUMAN EGG, magnified ten times.

(See page 14)

Courtesy Macmillan Company

Articles by

Allan Strong Broms, Edward G. Clemmer, Covington Hall, S. J. Holmes, Frederic A. Lucas, Joseph McCabe, N. K. McKechnie, Hugh F. Munro, Henshaw Ward

The Proofs of Evolution

By Henshaw Ward

(*This is the second of a series of three articles. The first, in September, consisted of two sections, "The Specialists are Unanimous" and "What Breeding Proves."*)

III. What the Rocks Prove

THE specialists who study all sorts of life on the earth unanimously believe that the millions of modern varieties have been produced by an evolution from ancient and simpler forms. But they are not unanimous about *how* the evolution worked. For example, some of the men who study life through microscopes feel that Darwin's idea of "natural selection" is not proved. The most famous and outspoken of these was William Bateson. In 1921 he made so strong a speech against Darwin's idea that the newspaper reporters told the world, "Bateson has overthrown Darwinism." To the readers of the papers this meant that Bateson had overthrown evolution.

No wild mistake in the news was ever wider of the mark than this. Bateson was merely discussing, before a convention of specialists, one of the technical details of the theory. The whole burden of his address was that the evolution theory stood unassailed. His closing words were these: "Let us, then, proclaim in precise and unmistakable language that our faith in evolution is unshaken. We have no doubts as to the reality or truth of evolution."

Bateson was much exasperated by finding that ignorant orators against evolution quoted him as an enemy of the theory. So he took pains to make a flat denial of their claims, in these words: "The lines of argument converging to support the theory are so forcible and so many that no alternative can be entertained. The geologic record is conclusive." That is, the story of evolution told in the rocks seemed, even to this skeptical worker with the microscope, an indisputable proof.

It is the most stupendous record that man has ever read. For two centuries the geologists have been at work deciphering it. Every discovery and every guess has been subjected to unsparing criticism. If any investigator won fame by describing a sunken continent or the effect of glaciers or the growth of coral islands, his book was read by a hundred keen skeptics; every one of them would have enjoyed ripping the argument up the back and throwing it on the junk pile. No shred of the story deciphered from the rocks has ever had a chance to survive unless it could stand the wear and tear of the tests put upon it by rival geologists.

No sentence of the vast history is based on imagination. Every paragraph of it is an explanation of facts that we can see with our eyes. The whole mass of proof from the rocks is as matter-of-fact as the three illustrations from everyday life that I give below.

(1) When I look at a field in March and see that a small boulder has been pushed up through its surface, I do not say that some devil has thrust it there to spite me. I ask a man who has had experience with objects that are heaved up in March, and he tells me at once that frost is the cause. He has seen hundreds of rocks and fence-posts lifted in the same way; the explanation always fits; no one has ever found any other explanation—not since fairies went out of fashion. Therefore no sane man disputes the theory that my boulder was pushed up by frost—though no man saw it pushed up.

(2) I see a gully through a ploughed field—the descending steps, the little sand-bars, the assorted pebbles, the scooped-out holes on the sides. I do not argue that an angel has been at work with a diamond trowel. I know from experience—every sane man knows—that rushing water once ran here and wore its bed.

(3) I see a track in a cement sidewalk. I don't say that Jack the Giant-Killer stamped it there after the cement was hard. Nor do I guess that it was made by an ostrich or a seal or a toad. I know that it was made by a dog that stepped on the sidewalk before it hardened.

The history of life on our globe has been pieced together by reasoning that is as plain and solid as the reasoning we all do about tracks and gullies and frost. The history is deciphered from the remains of ancient plants and animals found in rocks, called "fossils." These always occur in a certain order. There is, for example, a series of fossil shells in a cliff in southern France: kind A is near the top, kind B is lower down, kind C is next lower, kind D is lower still. Wherever on the surface of the globe a cliff contains these four kinds of shells, they are always in that same order. If any geologist could find in Utah or Peru or Tibet one single set of rocks in which kind C was above kind B, he would be famous and happy the rest of his life. A young geologist's idea of heaven would be to discover such an error in the history of life. But no geologist ever has detected such an error.

The history written in the rocks declares that there has been an order of development of plants and animals. Not even a Bateson disputes this. He finds the geologic record a conclusive proof of evolution.

IV. What Geography Proves

In the Pacific Ocean, six hundred miles west of the most westerly point of South America, lie the Galapagos Islands. They are a grim, lonely, and very ancient group of volcanic rocks and small islands that rise abruptly from deep water. On them are found some kinds of birds and shellfish and turtles that are found nowhere else in the world. Where did these come from? Were their ancestors created here, or did they fly and swim from South America?

In the Atlantic Ocean, eight hundred miles from any mainland, the Azores rise abruptly out of water that is two and a half miles deep. They are ancient volcanic islands. On them are some kinds of insects that are found nowhere else in the world. Were the ancestors of these insects created here, or did they migrate from somewhere?

On the other side of the globe, in the South Pacific, are coral islands. They are very young. And there are volcanic islands that are younger still—in fact some of them have been raised out of the ocean within the memory of man. Where do the animals on these islands come from?

The question that I have kept asking about the oldest and the youngest islands is a severe test of the evolution theory. For if evolution is true, the answer must be this: No plant or animal was ever created on an island, but it always descended from some ancestor that migrated to the island. And an evolutionist has to go further. He must say that no new kind of animal could ever be found on a young island. An evolutionist would even have to make this bold statement: The older an island is, the more will some of its animals differ from the original ancestors who swam or flew to it.

The facts bear out that statement. On a brand-new volcanic island not a shred of life is present. The first animals swim or fly to the island. On young islands no peculiar species of plants or animals are ever discovered. But on such ancient islands as the Galapagos some of the species are remarkably altered; they are peculiar to this one place, and are found nowhere else.

None of the sights that Darwin saw in his journey round the world was more astounding and puzzling than this difference between the animals that had not varied on the young islands and the animals that had varied profoundly on the old islands. Darwin was not then an evolutionist. He supposed that animals had been specially created in different parts of the world, and that to talk about their "varying to new species" was quite unscientific. But how could he account for the difference between the animals of the Galapagos and the animals of the young coral islands? It was clear that climate had nothing to do with the difference. The only solution he ever found—the only solution that all the world's naturalists have found since his day—was that when animals migrate to new surrondings their descendants vary to new species in the course of thousands of generations.

Ever since Darwin's day the naturalists have been mapping the geography of plant and animal life—what they call the "distribution" of it. They have gathered an immense body of most complicated facts about everything from moss to grizzly bears. Without evolution their knowledge would be a nightmare of contradictions. When they apply evolution their knowledge can be sorted into an orderly whole. So they consider the geographical facts one of the proofs of evolution.

Mind and Morals

By Hugh F. Munro

ALL that we know of human history, so far as it relates to the development of mental or moral characteristics, points to derivation from a lower animal form, believed to be the common ancestor of both ape and man. Tracing history backwards, we find that one after another of those characteristics, upon the possession of which we justly pride ourselves, disappears. Animal instincts and propensities come forward as the motive springs of action until no characteristic is left that can properly be called exclusively human. We have already seen that man carries in his body many vestigial organs, indicating a descent from a pre-human ancestor to whom such organs were useful. In his mental and moral nature he still carries "vestigial" propensities which, normally held in abeyance by his recently acquired intelligence, nevertheless spring up occasionally with the "unreasoning fury of the beast."

The lust, selfishness, greed, etc., which our higher selves find so hard to curb or eradicate, served a useful purpose in the animal economy, and by their nature point to it as their origin.

As dirt is to the chemist only matter in the wrong place, so qualities which were vitally useful to the animal are "evil" when they appear in man.

* * *

There is no doubt in the minds of scientists regarding organic evolution. There is no other hypothesis which can explain all of the facts, and not one fact has ever been brought to light which is incompatible with it.

There is not one of the sciences that have to do with the origin of man but has contributed its quota of evidence, although the data furnished by any one of them would be sufficient. Taken as a whole, their testimony is overwhelming to such a degree that evolution is now the working theory of every competent biologist. The method is still under discussion, but the fact itself has been fully established, never to be overthrown.

The Supreme Law

By Covington Hall

The Soul of Man is builded from a billion years of strife.—
The Iron Law of Struggle is the Supreme Law of Life;
Thru all, o'er all, it follows man wherever he may range,
The urge compelling progress and the power forcing change.

*Time never was when it was not. * * * Where atoms love and hate,*
It sows the seed of destiny, begins the work of fate;
Before the Earth was fashioned, before the Sun began,
Within the warring atom host was born the Soul of Man.

The Universe is subject to its mandate and its will,
Would, but for it, be shrouded in eternal darkness still;
Before the Gods were dreamed of, before the Christs were born,
The armies of the monads were embattled in the morn.

There never was nor will be from the strife of life surcease,
Within the warring Universe no universal peace;
No rest as long as motion lasts, as long as stirs a breath,
For peace is but Nirvana, and Nirvana is but death.

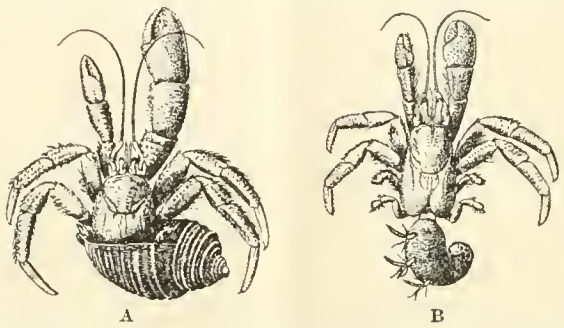
It is the law of being, fixt, immutable and right,
The essence of eternity, infinity and light;
All matter, mind and spirit, all is mothered out of strife,—
The Iron Law of Struggle is the Supreme Law of Life.

A Lesson From Lop-Sided Crabs

By S. J. HOLMES

THERE is a very odd family of crabs known in the jargon of the zoologist as the Lithodidae. All the members of this family are more or less asymmetrical, or lop-sided. The philosophical observer is naturally led to ask "How did they get that way? A specialist on crabs can give a very plausible answer.

The species of this family are very diverse in form, size and habits. Large spine forms inhabit the deep waters of the ocean. Small species, usually with rather soft bodies, are found among the rocks near the shore. One of these, Hapalogaster, lives under rocks and has the body very much flattened as if it had been run over by a heavy roller. Another, Cryptolithodes, has the shelly covering of the body drawn out into wing-like expansions that completely cover over the legs. Another is a short, pudgy creature with a form more like that of a typical crab. And there are various others. But amid the great diversity of forms characterizing the members of this group, there are certain well marked resemblances which lead zoologists to class them, without hesitation, in one family. They clearly constitute what is called a natural group.



A B

Hermit crabs. A Pagurus Hirsutiusculus, in a coiled shell. B. Pagurus Samuelis, removed from its shell. Note the egg-bearing appendages on the left side of the abdomen, and the larger right pincer.

Courtesy University of California

In all the species of the family the right pincer is larger and stronger than the left one. The last pair of legs is small, weak, and imperfectly developed. And, most striking of all, the abdomen is more or less one sided and *has appendages only on the left side.* In ordinary crabs these appendages are symmetrically situated on both sides of the abdomen. They are used for holding the eggs which are carried about by the females until the young are hatched. In the Lithodidae they perform the same function, although the complete absence of appendages on the right side naturally imposes a handicap. It is difficult to imagine any benefit to the species from such a peculiarity. The same condition is found in the large spiny denizens of deep water, the much flattened Hapalogasters, the highly modified, winged Cryptolithodes, and all the other species of this family. Why should all the species have the right pincer larger than the left, while in other asymmetrical crustaceans the larger pincer is found indifferently on either side of the body? The special creationist must assume that God endowed these poor crabs with the same kind of a handicap, quite regardless of their habits and the peculiar features of their environment. The arrangement could hardly be imagined to be of any use to them.

But leaving the creationist to wrestle with the difficulty let us consider what light may be shed by the theory of evolution. According to this theory the resemblances found in the members of a natural group owe their existance to the one cause of likeness among living creatures; descent from a common ancestor. In his endeavor to explain how the Lithodidae gained their peculiar one-sided condition the evolutionist would naturally look to the most closely related group, the hermit crabs. Most species of hermits have the peculiar habit of living in the coiled shell of mollusks into which they insert the abdomen. They present some obvious adaptations to this mode of life. Usually the pincers are unequally developed; the abdomen is soft and more or less twisted to fit the coil of the shell, and in the female is commonly furnished with egg-bearing appendages only on the left side. The posterior walking legs are also small and weak, since they are usually partly enclosed in the shell. They show a marked asymmetrical structure. Individuals frequently leave their shells, especially when they outgrow them, but they usually find a new one to inhabit before leaving their old domicile. The soft abdomen would be likely to fare ill without its customary protection.

The student who attentively compares the Lithodidae with the hermits will be struck with the many close resemblances. He could scarcely fail to come to the conclusion that lop-sidedness of the Lithodidae is a trait inherited from their hermit ancestors which owed it to their habit of living within coiled shells. The Lithodidae are hermit crabs which have left their shells and taken again to a free life. When we consider the close resemblances between these two groups, and the fact that the smaller and more primitive of the Lithodidae resemble the hermits most closely, this is the only rational interpretation that can be made. There are few cases in the organic world where the morphological evidence for descent is so peculiarly cogent.

Only through critically observing and comparing the structural characteristics of related organisms can one gain a really adequate conception of the morphological evidence for descent. Practically all who have qualified themselves to have an opinion by going through this kind of discipline have come to the same conclusion as to the fact of organic evolution.

C D E

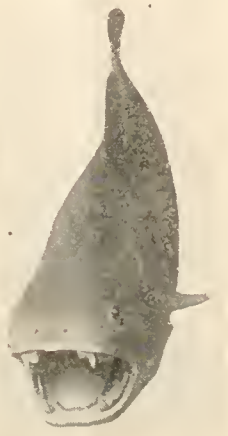
Various descendants of Hermit crab. Note larger right pincers. C. Hapalogaster cavicauda. Hairs removed from left legs and pincer. Common under rocks at low tide. D. One of larger species of Lithodidae from deep water off California coast. E. Cryptolithodes sitchensis, from below. Male; abdomen therefore shows little twist.

Courtesy University of California

The Earliest Backboned Animals

By Frederic A. Lucas,
Honorary Director, American Museum of Natural History

WE all like to know how things began and it is natural that we should ask, "What is the oldest known backboned animal and what did it look like?" Nature has been questioned in many ways to yield a satisfactory answer, the most direct being to trace back the history of animal life from fossil remains. But this method cannot go beyond a certain point, for the soft bodies of the very earliest animals were not preserved. To help out, the embryologist studies the early stages of developing individual animals, for these throw sidelights on the race history. Finally, invertebrates are studied, the structural parts of some being like those of vertebrates, while others actually are vertebrates in disguise. But these methods, have yielded variant answers, or the replies have been variously interpreted, so that some naturalists consider vertebrates descended from worms, others find their beginnings in crustaceans kindred to the King Crab.



Dinichthys, a giant Devonian Fish, as restored by Dr. Hussakof.
Courtesy Am. Mus. Nat. Hist.

Everyone knows how hard it is to trace a *family* pedigree back a few centuries, how the family name becomes changed and the line of descent obscure and how wide gaps soon appear. It is, of course, much more difficult to trace the pedigree of a *race* that extends, not over a few centuries, but over millions of years. The word "old" as we apply it to fossils has only vague meaning, for we call a family *old* whose pedigree runs back four or five hundred years, when it is actually but an affair of yesterday compared with even recent fossils. We may appreciate this better by recalling that, since the dawn of vertebrate life, enough of the earth's surface has been worn away and washed into the sea to form strata fifteen to twenty miles thick.

At the bottom, then, of twenty miles of rocks the naturalist finds the first scant remains of fish-like prevertebrates, the forerunners of the back-boned animals. The earliest consist of small bony plates, traces of cartilaginous back-bones, and some small conical teeth thought to be those of an animal like the lamprey. A little higher in the rocks, but not in the scale of life, are found a better preserved fish-like creature not over two inches long which is also related (probably) to the lamprey and the hag-fishes. These early vertebrates were so small and soft as to be preserved only when buried in mud immediately after death. Under the later pressure of miles of overlying rocks, their remains are often pressed out thinner than a sheet of paper, so that their shadowy outlines are very hard to trace. With such drawbacks to contend with, it is no wonder that naturalists should differ as to their relationships.

Still higher up we find abundant remains of small fish-like animals, clad in bony armor, indicating that they lived in troublous times when only the well protected could survive. Their plate armor enabled them to defy their enemies or rendered them such poor eating as not to be worth the taking.

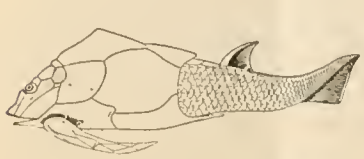
Pterichthys, the wing fish, was another small, quaint, armor clad animal whose remains were once taken for those of a crab. Its buckler, the part usually preserved, with its jointed, bony arms, certainly looks more like a crustacean than a fish. From occasional well preserved specimens we have a very exact idea of its protective cuirass. It had a mouth, of course, but no jaws, for the two do not necessarily go together. Also it had no hard backbone and the hard parts of its fins or arms were not inside but outside, like the legs of a crab.

These fishes and their allies were once the dominant type of life. In favored localities we find great deposits of their protective shields jumbled together. It is thought that portions of the Old Red Sandstone owe their peculiar tenacity to these dead fish. Just as boiling a plaster cast in oil makes it more durable, so the oil from these rotting fish would toughen the surrounding sandstone. Great numbers were probably caught in tidal pools along shallow shores and died when the pools were drained by the tide going out.

These fishes were little fellows and may be termed orphans of the past as they have no living relatives. Their immediate successors, preserved in the Devonian strata, were the giants of those days, termed, from their size and presumably fierce appearance, Titanichthys and Dinichthys (terrible fish) and are related to the living Ceratodus of Australia. We know almost nothing of their external appearance, however, for though they had powerful jaws and armored heads, they had no bony skeletons, as if they devoted their energies to preying on their neighbors rather than on internal improvement. They attained lengths of ten to eighteen feet; Titanichthys, with a gape of four feet, being able to devour anything known to live then.

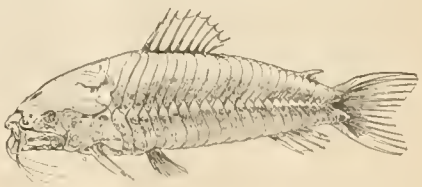
Succeeding them, in Carboniferous times, came a host of shark-like fishes, known mainly from their teeth and spines, their skeletons being only cartilage. Almost their only living relative is the little Port Jackson Shark. He also has a spine in front of his back fin and fortunately a mouthful of diversely shaped teeth; fortunately, because through their aid we can form some idea of the arrangements of the teeth found scattered through the rocks. For the teeth were not planted in sockets, as in higher animals, but simply rested on the jaws and were easily detached after death. To complicate matters, the teeth in different parts of the jaws were so unlike that when found separated they would hardly be suspected of belonging together. As the soft parts perished, the teeth and spines were naturally scattered, but from rare specimens that show, not only these hard parts, but the faint imprint of body and fins, we have learned just what teeth and spines go together and often find that one fish has received names enough for an entire school.

These ancient sharks were not the large and powerful species of today—these came upon the scene later—but were small and fitted (as their spines show) quite as much for defence as offence. But they quickly became the masters of the world, then as quickly declined in numbers, eventually almost to extinction. While sharks again increased, they never reached their former abundance and the species that arose were swift, predatory forms, better fitted to survive in the struggle for existence.



Pterichthys, the Wing Fish.

Cephalaspis, An Ancient Armored Pre-Fish.



Loricaria, a Modern Armored True Fish

Brains—How Come?

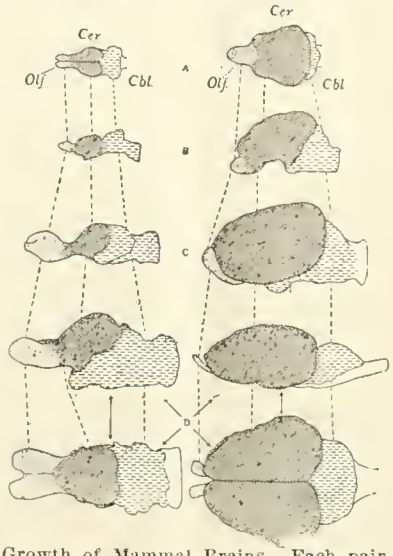
By ALLAN STRONG BROMS

III.

MIND and body are an inseparable pair. Always working together on their one job of living, they just had to grow up together. Certainly we cannot understand the evolution of either without considering the other. In our story of man and his mind, we have already found that it took a partnership between hands and brain to make a man of him and that his wise eyes did their new tricks of seeing and judging only when they got rightly connected in the switchboard of the brain.

But these are just recent, finishing touches, well within the last ten million years or so, the big start having been made by our remoter ancestors some *hundreds* of millions of years ago. For back of the ape-man and man-ape, back of monkey and tree-shrew, we must look to the primitive mammals, just emerging from the reptile ranks, to find the really big advance from which brains resulted. That big start dates from the acquiring of warm blood.

Our earlier ancestors, the reptiles, amphibia and fishes, were cold-blooded and led but sluggish lives. Some were capable of bursts of speed, but normally they just dozed around. Compare the energetic mammals or birds, both warm-blooded. All animals are engines that burn food-fuels within their bodies to keep themselves going. The cold-blooded tribe are, however, of the low-pressure type, generating only enough energy to get by, while the warm-blooded, high-pressure mammals and birds are a peppy lot, always on the go. The net result for them was bigger and better brains—as we shall see.



Growth of Mammal Brains. Each pair from ancient and modern animals of similar kind and body bulk.
Arctocyon A Dog
Phenacodus B Pig
Coryphodon C Rhinoceros
Uintatherium D Hippopotamus
Note decrease in olfactory (smell) lobes.

What started them off? Bad weather, probably. Perhaps the first of a long string of Ice Ages that repeatedly chilled off much of this world of ours. When the old cold-bloods get caught by freezing weather, all they can do is freeze up, too, and wait for the next thaw to revive them. But when this big freeze came on there was no thaw for thousands of years, and most of the numerous reptile tribe were wiped out.

A relative weakling among them, a reptilian-mammal, had acquired the trick of carrying his own warm climate around within himself. This helped him get through the long winter. Evidently the big bullies of his world had kept him chasing around so fast that he developed the hustling disposition, for which good, warm blood was necessary. He raised a whole crop of warm-blooded and active descendants,—predatory carnivores, hoofed herbivores, and some little insectivorous tree-shrews that led on to monkeys and man. His tribe took possession of the world, and blocked any real reptilian come-back.

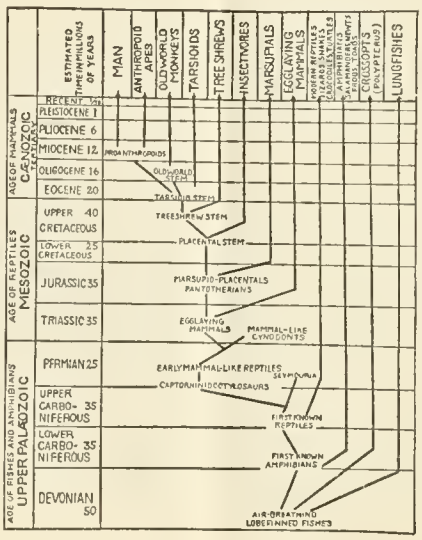
His blood itself contained more iron—the real bearer of oxygen, — but he also evolved ways and means of making and keeping it warm. He grew himself an overcoat—hair or fur. The birds used down and feathers. He developed mammalian legs, long and strong, to lift his body off the chilling ground. Most of the reptiles just sqnatted,—and froze. His four-chambered heart stopped the old leaks through which waste-filled blood had mixed with the clean, food-and-air-filled stream. Also his heart was more vigorous in pumping the blood around. Bigger lungs, worked by an active diaphragm, provided the forced draft of fresh air that kept the food-fuels burning intensely. For fresh air plus food-fuels yield living energy. Necessarily he also ate oftener and more heavily.

But there were hot days and hot spots, too, when he had to keep cool or burn out. Of course, he observed the usual hot weather rules, ate little, kept quiet and drank much. Drinking helped a lot, for he had acquired a new trick,—he could sweat. Sweating cooled him, for the moisture, evaporating, absorbed heat, much of it from his body. Also he installed a new thermostat unit in his brain, which automatically controlled all the valves and dampers and what-nots of his system, to keep him cool on the hot days and warm on the cold ones. He was all fitted out to go anywhere and stay through all the seasons. Best of all, he had pep. He could hustle a better living,—those bigger and more frequent dinners he needed to keep up the new pace. For this new pace was faster. The world was soon full of hustlers,—active mammals and birds everywhere, all looking for dinners, each trying to escape becoming someone else's dinner. The struggle for existence became more intense and only the very fittest survived. Natural selection was right there to hunt out improvements and preserve them. Evolution speeded up.

The big improvement was a better brain. Rather it was a new brain area, the neopallium, a clean switchboard not all cluttered up with old, poor connections. It did not happen in a day, of course, but evolved slowly, adding a part here for one job, another there for the next. Some parts gathered sight knowledge, others knowledge from smell or taste or touch or hearing. Certain portions took on the job of keeping the several parts in touch with each other, so they could compare ideas and make well-considered, joint decisions. Out of all this, slowly, came the human brain, so far the last word in its capacity to tackle new problems and adapt action to solve them.

His better brains made the mammal adaptable,—if he was careful about not specializing his body too much. Of course, if he took to the water as a fish-shaped whale, he could not expect to grow hands with which to do clever work and experiments. The birds tried over-specialization for flying purposes and it left them—up in the air. No hands, you see,—beaks being poor substitutes. Man's ancestors somehow stuck to the middle road, kept their adaptable bodies and cultivated the adapting brain. They could meet new conditions by changing their ways, without waiting for evolution slowly to transform their bodies. So they got by more often, raised more youngsters and passed their better brains along.

Less hindered by climate, they travelled and saw the world. Always on the go, they bumped into all sorts of things,—



The Family Tree of the Animals.

According to Wm. K. Gregory

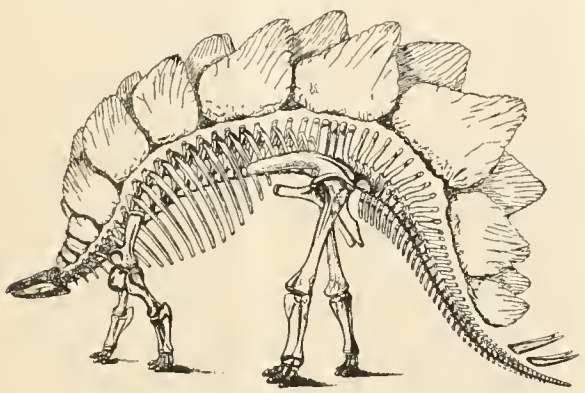
especially trouble. But more contacts meant more sensation-facts about the world, more things to consider and more actions to decide on. It took brains to develop sensitivity of touch and sight and hearing, brains to boss the lively body, brains to acquire skill in hands and feet and body and eyes. Mammal activity brought lots of troublesome problems and it took brains to work out practical solutions. In this active and aggressive world in which these ancestors of ours lived, better brains counted for more than ever. Natural selection did the rest. Keen competition and climatic severity, those were two big selective factors that forced the growth of the brains that made the man.

The next article will take us back to the fishes, where our hearing and posing and sense of balance began.

The Plated Lizard Stegosaurus

ALL the dinosaurs are extraordinary, but none more extraordinary than Stegosaurus, the plated lizard. He was about as tall as an elephant, but counting his tail, somewhat longer. Unlike some of the dinosaur tribe, he walked on all four feet, but his front legs were relatively small, the tall and massive hind legs being so centered as to carry the burden of his great weight.

Along the back of his body, neck and most of his tail, ran two rows of thin, sharp-edged and alternating plates, like the teeth of great saws. The largest were two feet high and wide and an inch thick, except at the heavier base where it embedded in the beast's tough hide. In life, the plates were probably covered with horn, making them somewhat larger.



Skeleton of Stegosaurus.

Near the tip of the tail, two pairs of large spines took the place of the plates. These spines varied in length with different species, ranging from eight inches to nearly three feet, with the largest base fully six inches in diameter. Like the back plates, the tail spines were increased in outward size by a covering of horn. Swung by the massive tail eight to ten feet long, the tail spines made a most formidable weapon.

But at his other end he was weak, for the head was much too small and the brain inside proportionately even smaller. Intelligence was utterly lacking, the routine functions of life being conducted by the nerve matter of the spinal cord. In fact, a portion of the spinal cord at the base of the tail was enlarged to twenty times the bulk of the brain. When Professor O. C. Marsh made and announced this discovery, the newspapers made the most of it by reporting a creature with two brains and B. L. T. of the Chicago Tribune took the poetic liberty of ascribing doubled intelligence to this most stupid of beasts. His poem makes poor science, but excellent reading.

"Behold the mighty dinosaur,
Famous in prehistoric lore,
Not only for his weight and strength
But for his intellectual length.

"You will observe by these remains
The creature had two sets of brains—
One in his head (the usual place),
The other at his spinal base.

"Thus he could reason a priori
As well as a posteriori.
No problem bothered him a bit;
He made both head and tail of it.

"So wise he was, so wise and solemn,
Each thought filled just a spinal column.
If one brain found the pressure strong
It passed a few ideas along.

"If something slipped his forward mind,
'Twas rescued by the one behind.
And if in error he was caught,
He had a saving afterthought.

"As he thought twice before he spoke,
He had no judgment to revoke;
For he could think, without congestion,
Upon both sides of every question.

"Oh, gaze upon this model beast,
Defunct ten millions years at least."

This "model beast" may be gazed upon at the American Museum of Natural History, New York City, which has a statuette restoration by Charles R. Knight. Yale University has a mounted specimen and the National Museum a life-size reconstruction.

Statuette of Stegosaurus
Courtesy American Museum of Natural History

EVOLUTION

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ARKANSAS ADOPTS ANTI-EVOLUTION LAW

The fundamentalists have won the first battle in their campaign to take control of the schools of the United States. They have just carried their anti-evolution law in Arkansas by an overwhelming majority. So now it is unlawful, in every tax-supported school of that State, to teach that "man has ascended or descended from any lower order of animals."

This was to be expected. Furthermore, we expect the fundamentalists to secure the adoption of similar anti-evolution laws in every State in which they submit the question to popular referendum vote, as long as the scientific world continues side-stepping this question.

Some wise men in Arkansas actually thought they might defeat the proposed law by keeping mum. Their tactic was based upon the mistaken notion that "the way to defeat the anti-evolution law is to keep the people from finding out what evolution really means." So they did not even try to take advantage of this wonderful opportunity to enlighten the people. Wherever "evolutionists" adopt such an abject attitude the fundamentalists are sure to win.

The opinion of some scientists that it doesn't matter what "the masses" think or believe is also fatal. They must realize that in a republic Mr. and Mrs. Average Man have votes, and their lack of understanding is of serious moment. If Mr. Scientist had to make his home in a swamp he would immediately plan to drain it to make it as healthy as possible for habitation. Yet he lives on serenely in the midst of a swamp of abysmal ignorance far more dangerous to the healthy progress of the race, without any feeling of responsibility toward it. So bigot and demagog take advantage of the situation.

Men of science must become aware of their social responsibility. It is not enough for them to know. They must pass their knowledge along, must try to bring to the mass at least some conception of what The Scientific Method means, at least an inkling of what it means to be scientifically Open Minded instead of dogmatic. They must make popular enlightenment their goal.

The fundamentalists will not stop with Arkansas. That is only their first step. Nineteen other States are open to fundamentalist attack via the Initiative and Referendum route, and they have sworn that in due time they will tackle all of them. And when they have sufficient foundation in these States they intend to put a law through Congress making all books and papers explaining evolution unmailable, besides "forcing the teaching out of every public school on the American continent."

What are YOU going to do about it? Remain discreetly aloof as you did in the case of Arkansas? Wait until the horses are all stolen before you try to shut the barn door? Wait until freedom of teaching is completely abolished before you begin to fight for it?

There is only one road to security of academic freedom. Not the ostrich-like pretense that there is no issue; not the cowardly camouflage that was prevalent in Arkansas: not a resting of the case on quibbles about the "constitutionality" of such ridiculously silly laws, but a NULLIFICATION of those laws through POPULAR ENLIGHTENMENT. Drain the swamps of ignorance through popular education in Natural Science, and the mosquitoes of bigotry that carry the poison of superstition will disappear and the human race will begin to lead a healthy mental life.

This is a tremendous task, but it is a noble task, and EVOLUTION calls on all who will to help. Men of science especially should now come forward as militant champions of the freedom to teach whatever facts are discovered, no matter with what preconceived notions they may conflict. Every opportunity should be utilized to educate the public as to what evolution means. Not only through the class-room, but through the platform, radio, movie, magazines and newspapers, ten thousand spokesmen of science should lift their voices, so that an understanding of the methods of science may replace popular superstition and bigoted belief.

Wherever fundamentalists raise the issue in a State Legislature or by launching a popular referendum the whole weight of every scientific body in the land should encourage the local teachers to make a stand-up fight for academic freedom and support them in it until victory is won.

DANGER IN DEMOCRACY

Those liberals who saw a cure-all for every ill in the Initiative and Referendum are being awakened rather rudely by the use to which this supposed instrument of progress is being put by the fundamentalists. Theres' danger in democracy unless it is based upon popular enlightenment. LET THERE BE LIGHT.

ISN'T THIS AGAINST THE LAW?

Science Service reports that a baby girl born recently in Knoxville, Tennessee, has a tail seven inches long.

RELIGIOUS LIBERTY?

Charles Smith, Atheist, native of Arkansas, went back to his home state to discuss the anti-evolution law.

He found that Arkansas already has a law making it illegal to mention the name of "God, or Jesus, our Savior" except in reverence or worship. So he was put in jail. When he appeared in court he was not permitted to testify because a clause in the Arkansas State Constitution prohibits any atheist from holding public office or testifying as a witness in court.

So in Arkansas our boasted "religious liberty" means only liberty to belong to one or another religious sect. If you don't, you're an outlaw.

TO WHOM IT MAY CONCERN—

Now that Arkansas has adopted its anti-monkey law we'll hear wise-cracks from many smart-aleck editors about the "backwardness of the backwoods", etc.

The fact is that the people of Arkansas stack up fairly well with the average in other States. Religious bigotry is still rampant everywhere. If it came to a popular vote fundamentalism would possibly carry even the States from which our wise editors look down on the rest of the country. Instead of considering the subject taboo as in the past, let them open their columns for some enlightening articles on Man's real place in Nature.

WHY NOT?

Since they have the devil on the run in Arkansas, the fighting fundamentalists should follow up their anti-evolution victory with another referendum to outlaw those twin heresies that the earth is round, and that it revolves around the sun.

* * *

Also, by all means, let's have a referendum to declare gravitation illegal.

* * *

And don't permit any one "in tax supported schools" to teach the circulation of the blood until "the hand that writes the pay-check" has voted on the subject.

* * *

Isn't Genesis a sufficient text-book on physics, chemistry, physiology and geology as well as biology?

"Wise men are instructed by 'Reason'; Men of less understanding by 'Experience'; The most ignorant learn by 'Necessity'." A. Nielen.

"The Vulgar can not remain quiet." Oliver Wendel Holmes.

"Against stupidity the gods themselves fight in vain." Schiller.

"What we have done for ourselves alone dies with us. What we have done for others and the world remains and is immortal." Albert Pike.

Twigs From the Family Tree

By N. K. McKechnie

Prologue

At the very summit of a pass in the Andes the traveler crosses a little stream, which if followed in its downward course he will find presently to be divided by a great rock bastion, so that one branch falls away to the eastward and eventually becomes part of a tributary of the Amazon, while the other turns to the west and joins a river that discharges into the Pacific. So a couple of twigs from the same tree thrown into the stream at its fountainhead may end their voyage to salt water with the breadth of a continent between them.

THE STORY

MANY hundreds of thousands of years ago,—so many that the exact number does not matter,—the long earth-wrinkle that now runs across Europe and Asia under the names of the Pyrenees, Alps, Carpathians, Caucasus and Himalaya mountains did not exist, and a semi-tropical forest stretched to the Pole itself.

Within the forest and on the great open spaces it enclosed, lived a multitude of creatures; some suggesting badly-drawn caricatures of animals familiar to us today, others totally unlike anything now living. Of flesh-eaters there were very very few; it was from herbs and trees that the animals obtained their sustenance. But the most striking feature by which the inhabitants of the earth in those days differed from our own was that search the round world over you would find never a man, nor anything so nearly resembling him as even a monkey. The remote ancestor from which the primates were to come was a little squirrel-like creature bursting with life and energy which led an intoxicating existence on the roof of the forest,—an ethereal country suspended between the earth and the sky; a swaying floor of creepers and interwoven foliage, laden with a mold of decayed leaves, moss and rotting wood, watered by thunder-storms, and manured by seed-bearing birds; with grasses growing and great fields of weeds shaded by the tops of the higher trees, perfumed by the great flowers of the parasitical creepers, and steaming with heat.

Here the ancestors of all men now living lived a joyous, carefree life for hundreds of thousands of years.

Then the mountains rose, and, cut off from the warm moist breezes of the southern ocean, the districts to the north changed in character. Gradually, very gradually, the vast luxuriant forests dwindled to scattered wood-lands clinging to moist situations; and from this by regional transitions to the vast prairies of the central European and Asiatic plains or the arid deserts of Tibet.

It was in the first stage of this changing environment that man was born, and the exigencies of our story demand we should view a typical case at close range.

Some millions of years ago on the northern slopes of a mountain range a troop of little animals are scampering across some open ground between two groves of trees. In the lead is the male, the Daddy of the band. He is about the size of an Irish terrier,—for our ancestors have grown considerably since our former glimpse of them—, and runs on all-fours in a clumsy fashion of his own. He doesn't like the solid ground and is much more at home in the trees, but what are you to do when you have exhausted the supplies in one feeding-place? You must naturally move on to the next. And it is well to move quickly because the ground is by no means so safe as in days of yore,—when one did not need to use it.

The flesh-eaters have come!

Not so numerous as they were yet to be, but sufficient to exercise a far-spread influence on their fellow-creatures.

Of these those that shrank from battle adopted various means to escape the Killers. Some took to the water and became seals or whales, some to the air like the bats, some burrowed into the ground like the rabbits and conics, and some like the little ancestors of the horse and deer cultivated the gift of speed.

What will man's ancestors do, bereft as they are of the forests that were their natural refuge from all enemies? Hard times ahead, Daddy! But if it is any consolation to you (and of course it isn't), let us state that not only *to* but *out* of trouble man is born.

Behind the old troop-leader are his harem and a miscellaneous swarm of his descendants,—at least most of them are his descendants. Of these the older of the young males keep a respectful distance from their formidable parent because there has been one of the constantly recurring family flare-ups that always occur when Daddy notices any of his sons taking an undue interest in the females of the band. That is the one thing that the old fellow will *not* tolerate. All dealings with the opposite sex are for him and him alone. And each year sees a certain number of half-grown males driven out from the family fellowship carrying on their persons the marks of their father's teeth. No such heresy as the rights of the younger generation can raise its head in these days!

Daddy reaches the fig-tree that was his objective and in a moment has swung himself upon a branch laden with the luscious fruit. Chattering volubly the band follows him, the tiny babies clinging fast to their mother's fur, and soon all are happy, fingers and jaws fully occupied.

Hunger appeased, their irrepressible spirits as usual find vent in play, and the tree is alive with their little furry forms, scampering along the branches in pursuit one of another, swinging from bough to bough, squealing with delight.

But suddenly there is an angry bark and Daddy comes hurtling through the air towards a young male he has detected in suspicious dallying with a lady. The culprit just saves himself by a lightning spring to another bough. Daddy is hard after him, bent on avenging this renewed outrage to his most sacred feelings. But, alas, advancing years have somewhat diminished his agility, and the active youngster keeps well ahead as they fly from branch to branch and tree to tree. At last the irate parent abandons the chase and returns in a very bad temper to where he has left his flock, pounces unexpectedly on another of his sons who is quite innocently pawing at a comrade swinging from loop of liana, and makes his teeth meet in his shoulder. There is a terrific squeal, repeated again and again as the old boy renews his attack, and this young one is given chase to and driven far away to join his companion in exile .

Then still grumbling, and with the remainder of the males keeping at a wide distance from his vicinity, the ruffled autocrat seeks the soothing society of the gentler sex.

And so it happened that when the next day a forest fire, kindled by a volcanic out-break (of which there were many in those days), came sweeping up the mountain side, the two young males, still separated from the rest of the party, were cut off from following them in their upward flight and barely avoided roasting by the lucky chance of a deep water-course that enabled them to escape with nothing more serious than some singed fur.

The band from which they were thus severed continued its panic-stricken flight before the devouring flames until a spot was reached where rocks and stunted shrubs gave check to their enemy. They entered a wide valley, which though they knew it not was a pass leading to the other side of the range, and here they wandered for two or three years, always moving forward because food was scarce, until at last they came to the southern end of the pass and a billowing sea of foliage lay below them stretching as far as the eye could see,—and thousands of miles further.

They had found the lost Paradise of their remote ancestors!

Let us leave them to the enjoyment of it and return to the two derelicts behind in the burnt-out wilderness.

(Continued in next issue)

Tampering With Tadpoles

By Joseph McCabe

Cases that appear in the press occasionally will have informed you that it is possible to graft flesh on a living body as well as to graft roses on cherry-trees. In the fully formed body there are limits to this power, but with embryos the most amazing results can be obtained. We can take two embryonic frogs, cut them in halves and graft the head half of one on the tail half of the other. This can be done even when they are of different species and different colors, and the frog which they then form is a very curious creature. We can cut out from the embryo of a newt a part of the skin which ought, in ordinary development, to form a nerve, and graft on to the place a group of the cells which form ordinary skin, and the newt will develop no nerve at that spot. We can cut a piece out of the embryo and turn it round, and the newt, when it is fully formed, will have that patch of its anatomy entirely misplaced. Its eyes, for instance, will be on its back, and the back part where the eyes ought to be. We can make the ears grow upside down. We can take the first rudiments of the legs and graft them on the side of the head, and they develop there just as they would in their proper place. I do not say that we can take any organ and make it grow anywhere, but in the case of an embryo in an early stage of development there is a most amazing power of transferring organs in this way. The "vital force" people must imagine that their architect has lost his head under the knife, so to say.

A still more curious series of experiments has been tried. When the embryo of a chick is developing in the egg it is surrounded by a membrane, and someone got the idea of grafting bits of other embryos on this. The budding limbs, for instance, of one chick embryo have been cut off and grafted on the outside of the membrane enclosing another embryo, and they develop there. In short, almost any organ can, in its rudimentary form, be detached from an embryo and made to grow on the outside of another embryo. Eyes, noses, ears, and even internal organs have grown in this totally unnatural medium. When the eyes or limbs or other organs are removed from an embryonic chick, the part of the brain which ought to deal with the working of the missing organ does not develop.

Thus embryologists are now convinced that what we call life is not some mysterious thing that belongs to the body as a whole but that each little group of cells has its own life. Most of us suppose that any part cut away from an organism loses its share of the "life" of the organism or can live no longer. This is found to be quite untrue as far as the embryo body is concerned. We can cut out a bit of the tissue from one of the organs, even the heart or the kidneys, and that group of cells will continue to live and grow; if, of course, it is kept in the proper conditions to feed and maintain it at the right temperature. In the warm fluid in a little glass tube the heart of the embryo chick, or even a section of the heart, will continue to beat long after it has been cut away from the body. These experiments were started more than ten years ago, and they have already proved a remarkable truth: it is that not only can parts of the body be kept "alive" when detached from it, but they will live a longer time in their isolated condition than they would in the body itself. Sections of the heart of an embryonic chicken have been kept alive in a tube for ten years, which is more than the life of a fowl.

Other series of experiments show the profound influence of environment on the developing body. Concentrated sea-water and other fluids will cause the development of an ovum which has never been fertilized, and some chemicals have curious effects which are quite unintelligible. We take, for instance, the eggs of a certain fish—not any fish—and let them develop in a solution of magnesium chloride instead of sea-water. When the body of the fish is fully developed, it is found to have one eye in the center of its forehead instead of a pair. Tadpole embryos in other chemical solutions have their eyes developed deep under the skin. All kinds of modifications of organs are caused by changing the chemical composition of the fluid in which the embryo is developing.

Some curious experiments in diet throw further light on this influence of the environment. The importance of the thyroid gland is well known, but its effect in the frog world is remarkable. If the extract or secretion of the thyroid gland be fed to tadpoles in an early stage they start at once to develop into frogs. The time these "doctored" tadpoles take to become little frogs is only about one-tenth the usual time. On the other hand, if the thyroid is removed from a tadpole it never becomes a frog.

In short, tens of thousands of experiments have been made on embryos, and the embryologist today finds that he can at will produce the most weird and wonderful forms. He can drug an ovum, and cause it to admit a sperm-cell of an animal of a different species and so make hybrids. He can make half animals or quarter animals or compound animals. He can cut an embryo into pieces and keep the pieces alive in so many glass tubes, the cells feeding, growing and multiplying just as if they were in what we call the living body. I should be inclined to say that he has proved that there is no such thing as a vital force or principle, for, clearly, such a thing could not possibly be divided.

Teacher: "What is the spinal column?"

Little Johnnie in the back seat: "It's a bone what runs up and down your back. Your head sits on one end, and you sit on the other."

JOSEPH McCABE

There may be a few of our readers who do not yet know of Joseph McCabe, who is to lecture under the auspices of Evolution, so here's a little introduction.

Joseph McCabe was born in England in 1867. Trained in various English schools and Louvain University. Was Franciscan Monk, 1883; Priest, 1890; Professor of Philosophy, 1890-1894; Rector Buckingham College, 1895. Left Church, 1896. Ever since then, for over thirty years, he has been writing and lecturing on rationalist, scientific and historical subjects in all the important countries of the world.

Among his writings of over one hundred volumes are: Twelve years in a Monastery, History of the Jesuits, Modern Rationalism, Principles of Evolution, Evolution of The Mind, A. B. C. of Evolution, Story of Evolution, The Ice Ages, and over fifty of the little Blue Books. He is also the author of The Key to Culture, a forty volume series published by Haldeman-Julius, an outline of all human knowledge.

McCabe is known on three continents as "The World's most learned Man", but his constant effort in his writings as well as his lectures has been to make this vast learning available and understandable to the ordinary man.

This year Joseph McCabe is lecturing in Canada, finishing his tour early in January on the Pacific coast. He has kindly consented to fill a limited number of lecture engagements under the auspices of Evolution on his return trip East through the United States. Those that already know him will need no urging to write for a date. Fundamentalists recognize in him their greatest foe, evolutionists their strongest champion. A lecture by McCabe will mean a mental awakening for your entire community.

A CORRECTION

Dr. J. A. Maryson of New York has kindly called attention to an error that crept into last month's article on the "Circulation of the Blood". It spoke of the red corpuscles as "boats of the blood stream carrying food matter and oxygen to the body tissues and carrying away the wastes." The fact is that, though the blood stream does carry food and wastes, the corpuscles carry only oxygen. In condensing this distinction was left out. The red corpuscles contain a substance called haemoglobin which unites loosely with oxygen in the lungs and turns red (being then called oxyhaemoglobin). When the corpuscles get into the body tissues, a difference in condensation causes the release of the oxygen which is then used up in the slow combustion which supplies energy to the living cells. The haemoglobin of the corpuscles then goes back to the lungs for another supply of oxygen.

We wish to thank the doctor for his correction. We are trying to keep Evolution free from scientific errors and appreciate the help which our readers may render by calling attention to mistakes.

The Amateur Scientist

A Monthly Feature *conducted by* Allan Strong Broms

HOW SEEDS TRAVEL

A walk through the fields or woods these autumn days gets one all stuck up with seed burrs of spanish needle, beggar ticks, cocklebur or burdock. All have seeds with

Bursting pod of wild bean. Hooks on fruits of cocklebur and burdock. Winged seeds of maple.

grapple-hooks to catch the furry coats of wandering mammals and hook free rides to distant spots so the plants may spread widely. Another method, more pleasing to the animals, is employed by the plants that enclose their seeds in tempting, pulpy fruit which ripens in conspicuous and attractive colors so that the seeds may be swallowed and carried away. As the seeds are hard and indigestible, they are presently dropped and thus planted far away from the parent plant.

For a big problem of plant life is to get the young out from under the stifling shadow of the old, a problem serious with us humans, too. Wide dispersal also means larger possible numbers with the consequent greater chances for race survival in the struggle for existence. Every favorable spot can be planted and occupied, so local extinction may not mean race extinction.

In the West, another effective method of seed dispersal is well known in the "tumbleweeds". After growing into large balls of twigs full of seed pods, they break loose and roll off before the wind, shaking out their seeds along the way. Usually they pile up in great heaps against the fences until the wind turns and sends them tumbling over the prairie again. The wind also serves many plants that grow wings on their seeds, the maple, basswood, Bignonia and Ailanthus for instance. Many smaller plants grow plumes and tails and tufts for seed parachutes, such as Clematis, fireweed, bulrush and dandelion.

Water currents of streams or ocean serve to spread many seeds that are buoyant or become so when swelled from soaking. Seeds may be carried over the seas a thousand miles in this manner, if only the ocean currents be right. Seeds buried in mud may stick to the feet of a migrating bird and be carried even farther. That such mud is loaded with seeds was proven by Darwin in one of his patient experiments. From a tea-cup of mud, kept covered for six months, he pulled 537 plants that germinated from the seeds it contained.

Several kinds of plants contrive to throw their seeds for some distance without depending on outside agencies. The fruit of a wild cucumber fills with water until it bursts, squirting a stream and its seeds several feet. The pods of the violet and witch hazel are so constructed that the ripened seeds are pinched and shot out with considerable force. The pods of the wild bean, "touch-me-not" and a domesticated "artillery plant" develop a twisting tension which causes them to throw their seed away violently when they suddenly break. Tropical travellers often hear the detonations of the exploding seed vessels of Hura crepitans, the "monkey dinner bell."

This is the season for wild seed planting. Next spring and summer, when you are down on your knees weeding the garden, you will know how well the job has been done.

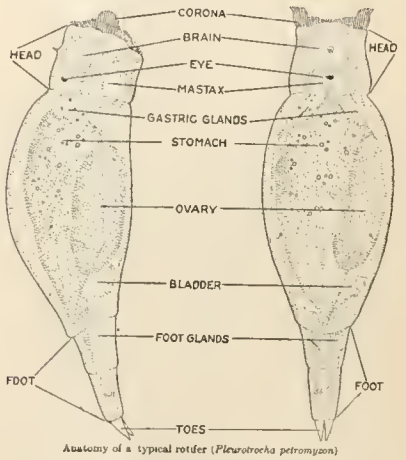
THE WHEELED ANIMALCULE

At the American Museum of Natural History a new group has recently been completed, modeled in glass and wax, magnifying a bit of pond water and its life a million times in volume. The most numerous of the inhabitants shown are the minute animals known as rotifers, whence the name "The Rotifer Group" given to this exhibit. The rotifers are a numerous tribe of many species, seldom longer than one-thirtieth of an inch. They are found almost everywhere in protected waters, either fresh or salt, and are partly responsible for keeping such waters pure and clean by eating the fine decaying particles which would otherwise accumulate and befoul. They are broadly classified into the limnetic or open water group and the littoral group found among the stems of water plants.

Viewed through a low-powered microscope, they are seen to be tube shaped, a tail "foot" at one end and at the other a broad head with what looks like a pair of moving wheels, whence the popular name, the "wheeled animalcule." These wheels are really rows of fine, vibrating hairs or cilia used in feeding and swimming. If the foot remains attached (by means of cement glands), the vibrations of the cilia cause water currents which sweep food particles into the centrally located mouth. When the foot releases, however, the cilia row the animal straight forward quite swiftly. As the body is transparent, the internal organs and processes can be seen. There is a complete digestive system and a simple nervous system with a head ganglion or "brain". It is one of the most simply organized of the multicellular animals and probably not far from the direct line of our primitive ancestors.

Its senses are limited as its possible responses are limited. There may be one, two or more eye-spots and some feelers for touch and perhaps smell. The slightest disturbance, because it means danger, causes the rotifer to retract or swim away. It feeds mostly on smaller unicellular plants and animals, such as bacteria, algae and protozoans. Its simple, yet hardened, "jaws" grind this food before the swallowing. In some species, the mouth parts are modified to pierce plant stems and suck out their contents. In predatory species, the "jaws" are pincers or are otherwise adapted for carnivorous pursuits, even to eating microscopic crustaceans.

The habits vary with the many species. The ordinary rotifers have a protective skin, but a few build hard tubes out of round "bricks" made by the animals themselves out of mucus. Some attach themselves to and are carried around by larger animals. Still others live quietly in colonies. At least one species creeps into the globular body of the protozoan cell colony Volvox, feeding parasitically upon the nourishment of its host.



Anatomy of a typical rotifer (*Pleurotrocha petromyzon*)

Anatomy of typical Rotifer. Side and top views. Corona of vibrating cilia. Mastax or jaws. Foot cement glands for anchoring.

The individuals we usually see are females, the males being smaller, fewer and shorter lived. The female can ordinarily do without the male, for the unfertilized eggs will produce young. But when winter approaches, many small eggs are laid and from them come males in great numbers. The eggs they fertilize are of a tougher breed, able to withstand the winter cold. Should the water dry away, the animal also dries into a speck of dust that the wind can carry off. In this condition, the rotifer (or its eggs) can survive for years. James Murray of the Shackleton Antarctic Expedition sank an eighteen-foot shaft to the bottom of a completely frozen lake, thawed out the mud and got living rotifers, frozen in perhaps centuries before. Because of this tenacity to life, rotifers can be gathered any time, wet, dry or in the egg, and a colony cultivated indoors for winter study.

The American Museum of Natural History, New York City, publishes two booklets, excellently written and illustrated, dealing with the rotifers and the new Rotifer Group. They can be secured from the museum at ten cents each.

Funnymentals

"No person who denies the being of a God shall hold any office in the departments of this State nor be competent to testify as a witness in any court." Sec. 1, Art. 9, Arkansas State Constitution.

"Before deserting their villages citizens of Mascali and Nunziata had taken the statue of St. Leonard within a short distance of the lava stream, hoping the ceremony would halt the flow from the volcano's crater." New York Telegram, Nov 7, 1928.

RED RUSSIAN RAVAGES

It cannot be disputed that there is a world-wide movement To wreck religion, overthrow governments, abolish marriage and usher in a regime with no God and no Bible. The program leaves destruction in its path—political upheavals, crime waves, sex pollution, atheistic campaigns. Russia went down. China is in a death struggle. England and America are threatened. Germany's iron militarism was builded upon the principle of evolution, namely, the idea that MIGHT MAKES RIGHT. We are informed that every prominent military leader in the German army was an evolutionist. The present moral breakdown and general chaotic condition of Russia can be traced directly to the application of animalistic psychology in its national life. Monkey men mean monkey standards of living. The very things that introduced a reign of terror in Russia are being taught through evolution and its by-products, in many institutions of learning. The red fumes of the pit are being wafted around the soul of America at this moment. Unless God speaks; unless America is swept with a Holy Ghost revival; unless the Bible is restored to its proper position; unless the national conscience of America is stirred, our doom is sealed.

—*Defender* (*fundamentalist*) *July*, 1923

"Who will dare deny that the ones who sign the pay checks are the ones to say what shall and what shall not be taught to their boys and girls? "Freedom to teach?" Yes, *within the limits I prescribe;* and if he does not like my terms, let him go and seek other employment." George McCready Price, November 1928.

GETTING WORSE AND WORSE

Reverend Leander S. Keyser, D. D., being taken to task in our columns (EVOLUTION, August, p. 12) for saying that ". . . man . . . harks back to the primordial proton or amoeba", hastens to explain (Bible Champion, Nov. 1928, p. 591) that "In a moment of forgetfulness I wrote 'proton' instead of "protozoan', which means first life-form." So the Reverend Doctor now wishes to be understood as affirming that "Evolution now means that man harks back to the primordial protozoan or amoeba and that all forms of present-day life have emerged from . . . a moneron, first life-form, or amoeba."

But since the amoeba is only an evolved moneron, and each is also a protozoon, the last state of the eminent anti-evolutionist's sentence is rather worse than the first! Guess again, Brother.

Edwin Tenney Brewster

WOULD YOU LET A PREACHER CUT OUT YOUR APPENDIX?

By EDWARD GRIEG CLEMMER

The high position of the United States in education is due to the fact that the management has been left to experts. Men and women who have made pedagogy their life work direct our educational institutions. It is to these specially trained people that the public must intrust the working out of curricula, just as we put our confidence in structural engineers to build our bridges, or to bacteriologists to safeguard our health.

The fathers and mothers of law or dental students are never consulted as to what their sons and daughters are to be taught. Nor do the parents interfere, because they know they do not possess the necessary knowledge. They are content to leave the management of law schools to lawyers.

On the same principle, scientists prescribe courses of study for scientific schools.

Now the Fundamentalists want to take this management out of the hands of experts and put it into the hands of people whose job it is to make the wheels of industry go around. They want an automobile man or cigar manufacturer to pass judgment on a line of work that is totally foreign to him.

The average person is not an expert in Paleontology or Anthropology. Then why should he be confronted at the polls with the task of deciding whether Evolution should be taught or not? Let the men whose business is Anthropology decide as to the subjects to be taught in that branch of science. Let the trained biologist, who has spent years of studying, decide, rather than the layman, who usually has not even a smattering of general knowledge, much less a professional education in science.

The Fundamentalist protests that Evolution is a religion, and as the constitution forbids the union of church and state, that Evolution should not be taught in the state-supported schools.

Evolution is no more a religion than relativity is. Evolution is not even taught as a philosophy. It is nothing more than a major tenet of certain sciences, in exactly the same way as the atomic theory or ionization in Chemistry or the law of gravitation in Physics. It is an explanation of many phenomena observed in nature and has been arrived at only through infinite toil.

Are the decisions of experts to be waved aside as "mere guesses" and the great men of science be forced into accepting the dictates of men who are not versed in the subject they wish to outlaw?

The man who is going to the polls to vote on the question of whether or no Evolution should be taught in the public schools should consider if he would want his appendix cut out by a minister.

From Our Readers

"Do you think your argument will gain favor by using the scathing "Funnymentals" column? By such vulgar methods you disgust the better class of educated people. If you have a beautiful, dignified truth to tell why not do it in a beautiful, dignified manner? Why smear it over with slimy mud throwing? I for one am too disgusted with your methods to care for your magazine." Maud Snyder, Nebraska.

"If you were as much interested in where souls spend eternity as you are in Where and How we were created you would be doing some good for humanity. May you get your eyes opened and realize that hundreds of souls are doomed through your theory." Mrs. Warren, California.

"Your good magazine EVOLUTION is a darb! I've spent much profitable time going over past issues, some of the time in deep thought and some of the time in chuckles over the wonderful irrationalism of the 'funnymentalists'." E. L. Van Artsdalen, Illinois.

"Your last number is nearer what your magazine should be. The articles are more readable for the "man on the street". My idea is to avoid writing for evolutionists and to treat your readers as beginners. Herewith check for $30 to be used as you see fit." M. Mark, Indiana.

"It seems to me that you make undue effort to prove something generally accepted by all intellectually developed people. Your opponents are the morons or fanatics, not quite rational human beings. The effort by legal enactment to fetter men's minds and compel the plastic age to accept falsehood and delusion is a return to the dark ages and presents a disquieting and discouraging outlook to thoughtful men." Charles Myers, New York.

"Mr. Bob Lyle of Biloxi sent me a copy. Didn't know there was such a good thing in New York. Enclosed find one dollar for subscription."—Ben Friedman, Tennessee.

"Received two numbers of your journal. It is a great start. I believe this is the only right way to cultivate the great principles of humanity. Let them know themselves. I wish you success. Here's money order for three subscriptions."—M. Haider, New York.

"Unquestionably your rugged and forceful periodical is what has long been needed: a magazine that will not appeal only to the 'high brow,' but as well to the 'man in the street' who has sufficient brains to grasp the simple truths of evolution and to be awakened to the growing menace to popular education in the activities of blatant fundamentalists."—Henry Frank.

To use the human reason
Is "Fundamental" treason;
Just go it blind,
Leave brains behind—
Like tails, they're out of season.
—*Bob Lyle*

FIVE THOUSAND DOLLAR PROMOTION FUND

The time is now ripe for a real promotion campaign to secure the basic circulation of Evolution that is essential to make it a self-sustaining magazine. Judging from results already achieved this can be done with a fund of five thousand dollars. We therefore invite our readers to contribute this amount. For every $10 paid in one share of the preferred stock and with every $50 an extra share of the common, voting stock in Evolution Publishing Corporation will be given. Let us hear from you AT ONCE to help us take advantage of the very favorable situation that has arisen because of the fundamentalist forcing of the anti-evolution law upon the State of Arkansas.

Contributions for this Fund to date are: Michael A. Cohn $20; Martin Dewey $200; M. Mark $30; John A. Bremner $10; Philip E. Adams $10; Wm. M. Wheeler $25; Thomas Barbour $100; H. W. L. Dana $10; Elihu Thomson $200; F. Gosling $30; A. Nielen $100. Total $735.

FOR ARKANSAS EDUCATION

The fact that it is now illegal to teach evolution in the schools in Arkansas will cause many natives that never bothered themselves about such questions before to scratch their heads and wonder what it is all about anyway. This means that they'll be in a receptive mood for Evolution. For every dollar sent in with specification that it be so used we'll send samples to twenty Arkansawyers and give them a chance to subscribe.

Contributions from the following are acknowledged since last report: Barrington Moore, $9; C. A. Johnson $2; Howard Lilienthal $5; Christine Ladd Franklin $10; Margaret Ladd Franklin $1; G. Obergfell $1; L. G. Crandon $4; Mrs. Earl Chichester $.25; F. E. Breithut $10; Harry W. Tyler $4; George H. Parker $4.50.

HONOR ROLL

Many of your friends, who would not take the issue raised by fundamentalism seriously before, will sit up and take notice now that the fundamentalist fanatics have captured their first State by popular referendum. They'll subscribe for Evolution now if you only ask them. Get them for a full year if you can, but, if they will not pay a dollar, collect at least two bits for a trial subscription. Let's enlist you in this Honor Roll.

20 H. Van Voorst	5 M. Holzbauer
19 Frank Masek	5 J. W. Bartels
12 Fred Blossom	5 C. D. Foreman
11 Mae Klavac	5 H. L. Clark
11 Geo. H. Parker	4 Henry Rimbach
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6 Chas. F. Clagg	3 Edith Gwin
5 C. P. Gillette	3 Aleck Bodnack
5 H. R. Rentsch	3 F. Cassidy

THIS PUZZLING PLANET, by Edwin Tenney Brewster. Bobbs-Merrill Company, $4.00.

Professor Brewster must be criticized for the way he almost apologizes for his literary method,—the method that mixes field-observation, history and biography, as if there were something wrong with that. Why it is this very method that makes his telling so good. I rather suspect he was not apologizing at all.

The book tells the Earth's unfinished story, how men have read it in the past and how the wayfarer may read it today. It is well and amply told, too, even though it is relatively brief and popular. It gives all the leading clues, so that each of us may interpret for himself. As we are all surrounded by "geology" in every rock and hill and sand bank, that gives us unending stories to read—once our eyes have been taught the language. Thereafter there are no tiresome journeys; one need only flatten one's nose against the car window to attain whole days of delight.

This Puzzling Planet is a fit sequel to the author's *Creation; a History of Non-Evolutionary Theories,* that other delightful book which deals largely with the story of biology. There is no fundamentalist comfort in either, for both tell the story of persistent clerical errors, still paraded as final truth by the ultra-orthodox—and laughed at by any one who has studied and knows. Both books are full of ammunition for the militant. Ammunition he certainly needs, for the holy absurdities do not die just because they have been once killed. They still persist, even amongst our enlightened selves, as witness the fact that a full half of our American people still firmly hold to the geology of the Flood of Noah. And of course, no issue of a Fundamentalist journal is quite complete these days without its article upholding this last hope of the theological stand-patters. Brewster devotes a chapter to its history and tribulations that will make the Fundamentalist tear his hair. A. S. B.

LET FREEDOM RING, by Arthur Garfield Hays, Boni & Liveright, $2.50.

The adoption of the anti-evolution law by the State of Arkansas on November 6th emphasizes the timeliness of "Let Freedom Ring" by Arthur Garfield Hays, published recently by Boni and Liveright. It deals at length with the "Scopes Case", that mid-summer farce that had the whole world giggling three years ago. Mr. Hays was one of the dramatis personae and tells the story from behind the scenes, giving many intimate glimpses of the actors.

And he gives a picture of the folk in Tennessee that is an essential part of America, a part seldom seen by visitors to our shores and seldom recognized by our "cultured classes", but which must be taken into consideration in any serious evaluation of the actions of America.

One who has studied science, who has the evolutionary concept, finds it hard to appreciate the viewpoint of those whose lives are ruled completely by dogmatic belief. This study of the Scopes case by Mr. Hays will help to such an understanding. And this is essential to an intelligent handling of the issues raised by militant fundamentalism, encouraged by its victory in Arkansas to try for power.

But to Mr. Hays this suppression of the Freedom of Education is only one manifestation of a quality in American character that also finds expression in other ways. These are indicated by the chapter headings:- 2. Freedom of Speech and Assemblage (Pennsylvania coal mines); 3. Freedom of the Press (American Mercury); 4. Freedom of Residence (Detroit Negro Segregation); 5. Freedom of the Stage (Captive Case); 6. Freedom of Opinion (Sacco-Vanzetti). Each of these cases depicts trials in which Mr. Hayes was a personal participant as one of the Champions of Freedom.

The stories are interestingly told with a wonderful sense of the dramatic. There is no profound analysis of underlying causes, no ultimate solution of problems, but a frank facing of reality which is an essential prerequisite to such analysis and solution. Readers of Evolution will enjoy this book and find it food for thought. L. E. K.

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OUR COVER

Our cover this month shows the human egg magnified ten times. From such a single cell, apparently simple in structure, each of us has grown. By absorbing nourishment from the mother, this cell grows and divides into two, then four, eight, sixteen, and so on until there are millions of them, of all shapes and uses. In this development, the human embryo passes through several ancestral stages of our race evolution, through sponge, worm, fish and tadpole, for example. At one time it has gill slits along its neck and a tail longer than its body.

This cover idea must be credited to the delightful children's book, "Growing Up", by Karl de Schweinitz, which tells them the true story of sex and birth. This is only one of the many clever pictures with which it is so interestingly illustrated.

STATEMENT OF THE OWNERSRIP, Management, Circulation, etc., required by the Act of Congress of August 24, 1912, Of EVOLUTION, published monthly at New York, N. Y., for Oct. 1, 1928.

State of New York,)
Connty of New York,) ss.:

Before me, a Notary Public in and for the State and county aforesaid, personally appeared L. E. Katterfeld, who, having been duly sworn according to law, deposes and says that he is the Managing Editor of the EVOLUTION and that the following is, to the best of his knowledge and belief, a trne statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of Augnst 24, 1912, embodied in section 411, Postal Laws and Regnlations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Evolution Publishing Corporation, 96 Fifth Ave., New York, N. Y.; Editor, none; Managing Editor, L. E. Katterfeld, 96 Fifth Ave., New York, N. Y.; Business Manager, L. E. Katterfeld.

2. That the owner is: Evolution Publishing Corporation, 96 Fifth Ave., New York, N. Y.; L. E. Katterfeld, 96 Fifth Ave., New York, N. Y.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

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5. That the average number of copies of each issue of this publication sold or distribnted, through the mails, or otherwise, to paid subscribers during the six months preceding the date shown above, is ———
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L. E. KATTERFELD.

Sworn to and subscribed before me this 11th day of October, 1928.
(Seal) JOSEPH R. BRODSKY.

Prof. Heber D. Curtis, Director of the Alleghany Observatory, will lecture on "The Unity of the Universe" at the meeting of the Amateur Astronomers Association at the American Museum of Natural History at 8:15 P. M., Wednesday, November 21st.

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"I wish it might be possible to compel each of the two hundred and fifteen thousand clergymen in the United States to read every word of it to the adult men of their congregations. Then, as a further punishment to the ministers, they should be prosecuted for corrupting the morals of men by reading the Bible to them.
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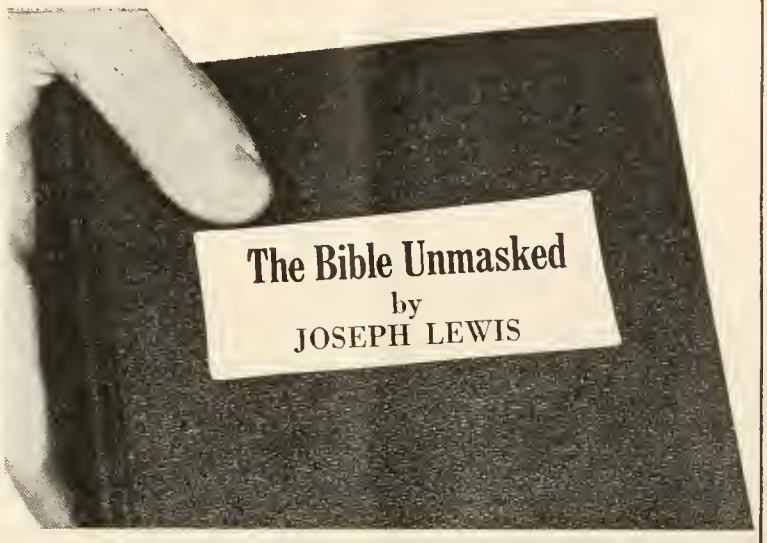

A CHALLENGE TO THE WORLD

Everybody knows something about the Scriptures. All of us are vaguely familiar with it. But few really know exactly what it contains. Some people who have "read" the Bible all their lives are astounded when the real truth is brought to their attention.

Once the Bible was held to be supreme in science art, philosophy. Today we no longer accept it for any of these things. In every field of knowledge which has effected human happiness and progress, the authority of the Bible has been rejected.

Today it is still claimed for the Scriptures that they give man a workable code of morals. But is that true? We know that the Bible has been proved wrong in all of its claims to authority. It is only natural, then, that even this last shred of authority should be doubted. And this last claim is torn away from the Bible by Joseph Lewis, in his astounding book, "The Bible Unmasked." An eminent writer has declared this book to be "the most daring exposure of modern times, and recalls the satire of Voltaire, the reason of Paine and the eloquence of Ingersoll." The conclusions of this indomitably amazing book cannot be avoided. It is a challenge to the entire world.

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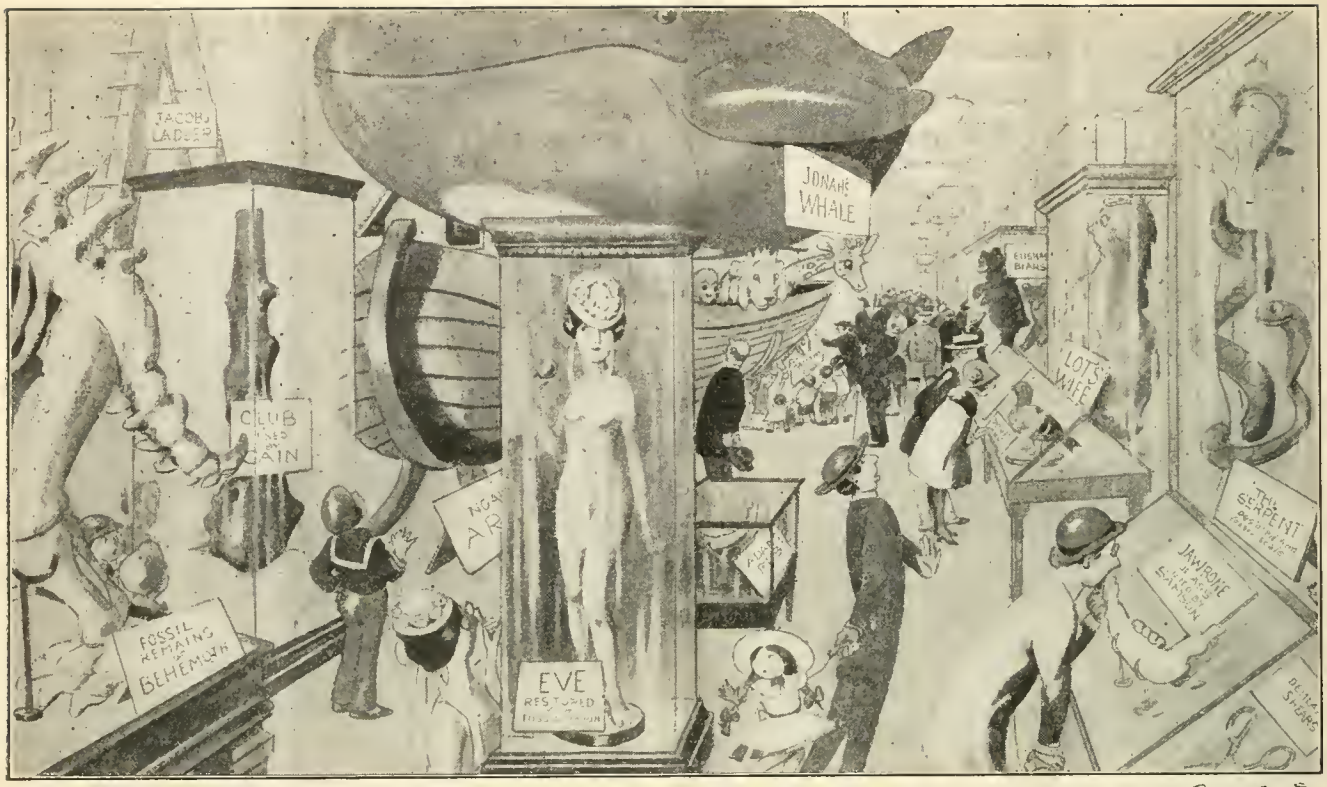

According to Law—In Arkansaw

A "Funnymental" Museum as pictured in "Life" by Oliver Herford. Reprinted with their kind consent. Copyright, 1924, by Life Pub. Co.

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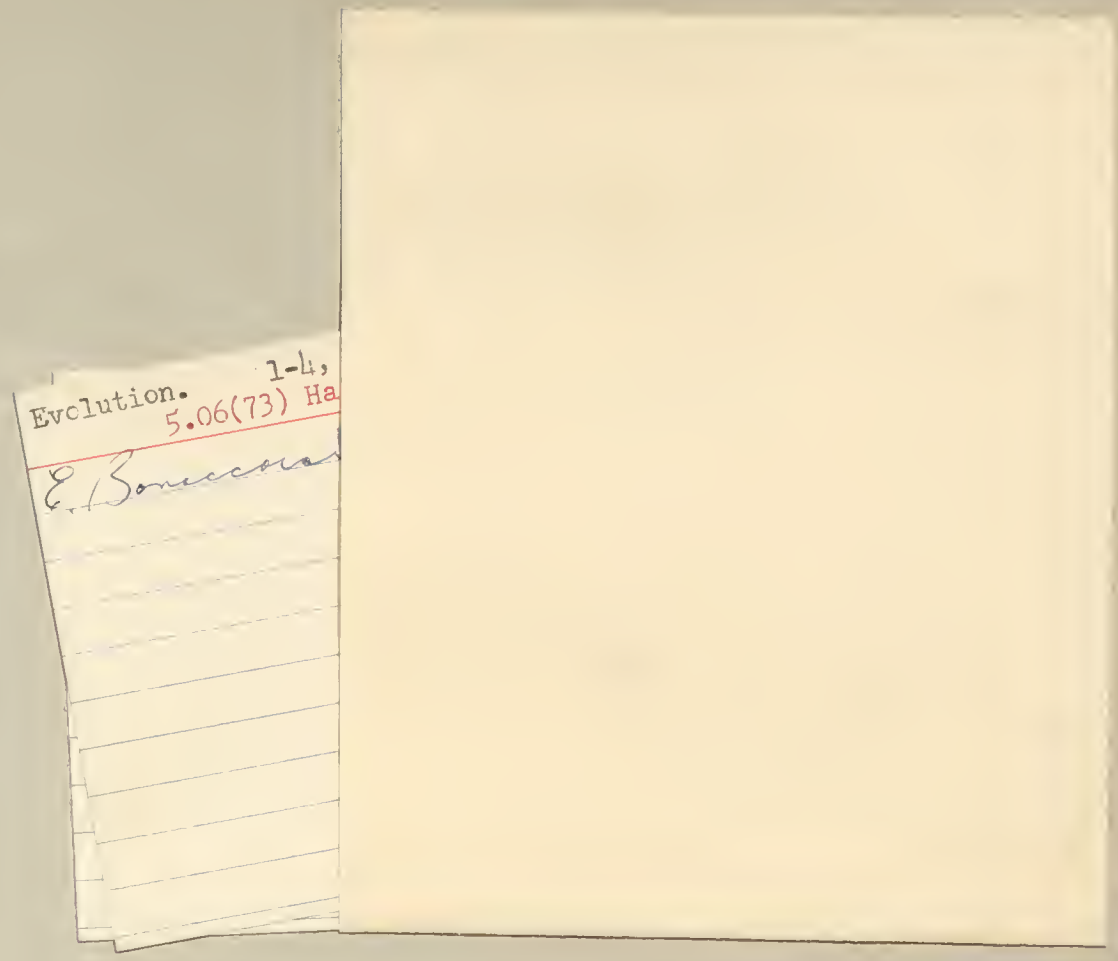

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